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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/781,786	02/12/2001	Kyung-Ju Choi	00-6AAF (DN7814)	6972

7590 02/14/2002

Polster, Lieder, Woodruff & Lucchesi
763 South New Ballas Road, Suite 160
St. Louis, MO 63141

EXAMINER
REVIS, ELIZABETH A

ART UNIT	PAPER NUMBER
1723	3

DATE MAILED: 02/14/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/781,786	Applicant(s) CHOI, KYUNG-JU
	Examiner Elizabeth Revis	Art Unit 1723

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02/21/01* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-27* is/are rejected.

7)☒ Claim(s) *1,10,14,15,20 and 27* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities:

-Page 8, Line 6 recites "bracketed carding sections 6 and 6', the **bracket** heating sections…," should it say bracketed?

-Page 8, Line 7 recites "Mixer-blender section 4, as shown Figure 1A," should it say as shown in?

-Page 14, Line 6 recites "In accordance with the novel invention this calculation can be made by the **formulas express**:," this is unclear.

-Title states "Product and method of forming **succesive** layers of face-to-face adjacent media with calculated pore size," word in bold is misspelled.

Appropriate correction is required.

Claim Objections

2. Claims 1, 10, 14, 15, 20 and 27 are objected to because of the following informalities:

With respect to claim 1, it recites "A multi-layer filter media comprising a combination of at least two successive adjacent face-to-face **thicknesss**," word in bold is misspelled.

With respect to claim 10, it recites "The filter media of Claim 9, said chemical binding agent being **a** selected acrylic **binders**," if you say **a**, it should state **binder**.

With respect to claim 14, Line 6 recites "(40) percent six (6) denier fibers, ten (10) percent three (3) denier fibers and fifty (50) **per cent**...," comma in bold is missing and percent has an extra space.

With respect to claim 15, it recites "The filter media of Claim 1, wherein said layers comprise a coarse **thicknesse**...," word in bold is misspelled.

With respect to claim 20, it recites "The method of manufacturing filter media of **19**,..." the word Claim is missing.

With respect to claim 27, it recites "A method of manufacturing multi-**layerd**...," word in bold is misspelled.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 23-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. With respect to claim 23, it refers to the method of manufacturing of claim 17, however claim 17 is not a claim relating to the method of manufacturing. With respect to claim 24, it is further dependent on claim 23. With respect to claim 25, it refers to the method of manufacturing of claim 15, however claim 15 is not a claim relating to the method of

manufacturing. For the purposes of examination, the examiner assumed the claims 23 and 25 to be dependent on a general method of manufacturing claim, such as claim 19.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 6, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Choi (5,968,373) in view of Baravian (4,560,385). With respect to claim 1, Choi discloses a multi-layer filter media comprising a combination of at least two successive adjacent face-to-face thicknesses of fibers, said fiber sizes of each thickness having a combination of fiber sizes so that the pore size characteristics of one thickness differs from that of an adjacent thickness with said fibers of one thickness being comparatively finer than said fibers of said other thickness (Col 3, Lines 10-15) and with the fiber sizes and pore sizes of said successive adjacent face-to-face thicknesses of fibers being calculated so that the overall average pores size of the combined successive thicknesses is smaller than the pore size of the combination of finest fiber thickness (Col 3, Lines 60-65), so as to optimize filtration performance efficiency. Choi does not disclose said fibers being carded and/or chopped.

Baravian teaches fibers being carded and chopped (Col. 1, Lines 15-20). It would have

been obvious to one of ordinary skill in the art at the time the invention was made to use carded, chopped fibers in Choi, as taught by Baravian because it is well known in the art as the dry process (Col. 1, Lines 9-20).

With respect to claim 6, Choi discloses the multi-layer filter media of claim 1 as stated above, wherein said thicknesses being of separate face-to-face thicknesses (Col. 2, Lines 10-20, Col. 3, Lines 10-15).

With respect to claim 11, Choi discloses the filter media arrangement of claim 1 as stated above, wherein said successive thicknesses extend horizontally, with the upstream thickness of said combined successive thicknesses being of higher porosity and higher denier characteristics than a downstream thickness (Col. 2, Lines 11-20).

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian as applied to claim1 above, and further in view of Ahr (U.S. Statutory Invention Registration H1, 909). As stated above in reference to claim 1, Choi in view of Baravian discloses a multi-layer filter media comprising a combination of at least two successive adjacent face-to-face thicknesses of carded, chopped fibers, said carded, chopped fiber sizes of each thickness having a combination of fiber sizes so that the pore size characteristics of one thickness differs from that of an adjacent thickness with said fibers of one thickness being comparatively finer than said fibers of said other thickness (Col 3, Lines 10-15) and with the fiber sizes and pore sizes of said successive adjacent face-to-face thicknesses of fibers being calculated so that the overall average pores size of the combined successive thicknesses is smaller than the pore size of the combination of finest fiber thickness (Col 3, Lines 60-65), so as to optimize filtration

performance efficiency. Choi in view of Baravian does not disclose said fibers of each thickness being substantially opened and aligned.

Ahr teaches fibers being substantially opened and aligned (Col 16, Lines 60-65). It would have been obvious to one of ordinary skill in the time that the invention was made to have the fibers of Choi in view of Baravian opened and aligned, as taught by Ahr so that they are in a substantially uniform density with a low level of nits or knots (Col 16, Lines 60-65).

8. Claims 3-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian as applied to claim 1 above, and further in view of Badolato et al. (4,732, 675).

With respect to claim 3, Choi in view of Baravian discloses the multi layer filter media of claim 1 as stated above. Choi in view of Baravian does not disclose the fiber size characteristic of one thickness being less than six denier and the other being at least six denier.

Badolato et al. teaches the denier of one thickness to be less than six denier (Col. 2, Lines 33-35), and the other at least six denier (Col. 2, Lines 47-49). It would have been obvious to one of ordinary skill in the art at the time the invention was made to place these specific denier measurements in Choi in view of Baravian as taught by Badolato et al. since the denier characteristics would be tailored for the specific filtering application (see Villiers et al. (5,480,464), Col. 5, Lines 10-16).

With respect to claim 4, Choi in view of Baravian discloses the multi-layer filter media as stated above in claim 1. Choi in view of Baravian does not disclose at least three different denier fibers with the denier characteristics of each being approximately one to four, six, and at least twenty, respectively.

Badolato et al. teaches at least three different denier fibers with the denier characteristics of each being approximately one to four, six, and at least twenty (Col. 2, Lines 30-60). It would have been obvious to one of ordinary skill in the art at the time the invention was made to place these specific denier measurements in Choi in view of Baravian, as taught by Badolato et al since the denier characteristics would be tailored for the specific filtering application (see Villiers et al. (5,480,464), Col. 5, Lines 10-16).

9. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian as applied to claim 1 above, and further in view of Villiers et al. (5,480,464). Choi in view view of Baravian discloses a multi-layer filter media as discussed above in claim 1. Choi in view of Baravian does not disclose said combined thicknesses of filter media being integral.

Villiers et al. teaches combined thicknesses of filter media being integral (Col. 5, Lines 35-55). It would have been obvious to one of ordinary skill in the art at the time the invention was made for the thicknesses of filter media of Choi in view of Baravian to be integral, as taught by Villiers et al. for increased rigidity and stability of the media (Col. 5, Lines 45-50).

10. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian as applied to claim 6 above, and further in view of Villiers et al. With respect to claim 7, Choi in view of Baravian discloses a multi-layer filter media as discussed in claim 6 above. Choi in view of Baravian does not disclose said face-to-face layers of filter media including layer bonding between said faces.

Villiers et al. teaches face-to-layers of filter media including layer bonding means between said faces (Col. 5, Lines 40-50). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include layer bonding means in the filter media of

Choi in view of Baravian, as taught by Villiers et al. for increased rigidity and stability of the media (Col. 5, Lines 45-50).

With respect to claim 8, Choi in view of Baravian discloses a multi-layer filter media as discussed in claim 7 above. Choi in view of Baravian does not disclose said carded, chopped fibers having low melt characteristics with said layer bonding means comprising a thermal binding.

Villiers et al. teaches said fibers having low melt characteristics with said layer bonding means comprising a thermal binding (Col. 5, Lines 10-55). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include low melt characteristic fibers with thermal binding in Choi in view of Baravian, as taught by Villiers et al. for increased rigidity and stability of the media (Col. 5, Lines 45-50).

11. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian and Villiers et al. as applied to claims 6-7 above, and further in view of Rotter (5,425,672). With respect to claim 9, Choi in view of Baravian and Villiers et al. disclose the filter media of claim 7 as discussed above being of separate face-to-face thicknesses and including layer bonding means between said faces. Choi in view of Baravian and Villiers et al. does not disclose said layer bonding means comprising a chemical binding agent.

Rotter teaches said layer bonding means comprising a chemical binding agent. (Col. 6, Lines 1-10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a chemical binding agent in Choi in view of Baravian and Villiers et al., as taught by Rotter for forming a relatively rigid mat (Col. 6, Line 9).

With respect to claim 10, Choi in view of Baravian and Villiers et al. disclose the filter media of claim 9 as discussed above being of separate face-to-face thicknesses and including layer bonding means between said faces. Choi in view of Baravian and Villiers et al. does not disclose said chemical binding agent being a selected acrylic binder.

Rotter teaches said chemical binding agent being a selected acrylic binder (Col. 6, Lines 7-10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use an acrylic binder in Choi in view of Baravian and Villiers et al., as taught by Rotter for forming a relatively rigid mat (Col. 6, Line 9).

12. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian. Choi in view of Baravian discloses the filter media of claim 1 as discussed above. Choi also discloses $\left(\frac{M_2}{M_1 M_3}\right)^2 = \frac{L_2}{L_1 L_3}$, where M is the mean flow pore size and L is the corresponding thickness, for a triple layer medium (Col. 6, Lines 20-65). Choi in view of Baravian does not disclose $\frac{1}{M} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n \left(\sum_{i=1}^{n} \frac{1}{M_i}\right)$. It would have been obvious to one of ordinary skill in the art at the time the invention was made to include the ratio of the pore volume to the total volume of the media, ε, in the equation of Choi, and solve, thus yielding the above equation to design the multi-layer filter media (Col. 6, Lines 64-65) by the prediction of the average pore size for "n" layered media.

13. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian as applied to claim1 above, and further in view of "Prediction Of Air Permeability And Pore Distribution Of Multi-Layered Nonwovens" by Choi, hereafter referred to as Choi2. Choi

in view of Baravian discloses a filter media as discussed in claim 1 above. Choi in view of Baravian does not disclose the air frazier permeability equation as adapted to "n" layered media:

$$\frac{1}{v} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n \left(\sum_{i=1}^{n} \frac{1}{v_i}\right).$$

Choi2 teaches the following equation: $v = \left(\sum_{i=1}^{n} \frac{1}{v_i}\right)$, which with the addition of the ratio of the pore volume to the total volume of the media, ε, would yield the claimed equation. It would have been obvious to one of ordinary skill in the art to use the equation in Choi in view of Baravian, as taught by Choi2, to predict the air permeability and the pore distribution of the multi-layered nonwoven filter medium (P. 62, 1st paragraph).

14. Claims 14-17 rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian as applied to claim1 above, and further in view of Villiers et al. With respect to claim 14, Choi in view of Baravian discloses the filter media of claim 1 as discussed above. Choi in view of Baravian does not disclose said thicknesses comprising a coarse thickness and an intermediate thickness of fibers all of approximately one to two inches in length with the coarse thickness advantageously approximately comprised of 30 percent 15 denier fibers, 30 percent 6 denier fibers, and 40 percent 6 denier low melt fibers and the intermediate thickness advantageously comprised approximately of 40 percent 6 denier fibers, 10 percent 6 denier fibers and 50 percent 4 denier fibers.

Villiers et al. teaches a multi layer filter media comprised of a combination of low melt and regular fibers of approximately 1-2 inches in length. Villiers et al. does not teach the specific percentages of denier fibers. In Column 5, Lines 10-16, Villiers et al states "The relative percentages of the components and fibres . . . will determine the performance of the efficient

layer and will be selected bearing the desired characteristics in mind." Since no particular reason for these specific percentages is claimed, it is understood that they are for a specific performance as stated by Villiers et al.

With respect to claim 15, Choi in view of Baravian discloses the filter media of claim 1 as discussed above. Choi in view of Baravian does not disclose said layers comprising a coarse thickness and a fine thickness of fibers all approximately one half to two inches in length with the coarse thickness advantageously comprised approximately of 30 percent 15 denier fibers, 30 percent 6 denier fibers, and 40 percent 6 denier low melt fibers; and, the fine thickness advantageously comprised of 40 percent 3 denier fibers, 10 percent 1 denier fibers, and 50 percent 2 denier low melt fibers.

Villiers et al. teaches a multi layer filter media comprised of a combination of low melt and regular fibers of approximately 1/2-2 inches in length. Villiers et al. does not teach the specific percentages of denier fibers. In Column 5, Lines 10-16, Villiers et al states "The relative percentages of the components and fibres . . . will determine the performance of the efficient layer and will be selected bearing the desired characteristics in mind." Since no particular reason for these specific percentages is claimed, it is understood that they are for a specific performance as stated by Villiers et al.

With respect to claim 16, Choi in view of Baravian discloses the filter media of claim 1 as discussed above. Choi in view of Baravian does not disclose said thicknesses comprising a coarse thickness, an intermediate thickness and a fine thickness all of approximately one half to two inches in length with the coarse thickness advantageously approximately comprised 30 percent 15 denier fibers, 30 percent 6 denier fibers, and 40 percent 6 denier low melt fibers; the

intermediate thickness advantageously comprised approximately of 40 percent 6 denier fibers, 10 percent 3 denier fibers, and 50 percent 4 denier low melt fibers; and, the fine thickness advantageously comprised approximately of 40 percent 3 denier fibers, 10 percent 1 denier fibers, and 50 percent 2 denier low melt fibers.

Villiers et al. teaches a multi layer filter media comprised of a combination of low melt and regular fibers of approximately 1/2-2 inches in length. Villiers et al. does not teach the specific percentages of denier fibers. In Column 5, Lines 10-16, Villiers et al states "The relative percentages of the components and fibres . . . will determine the performance of the efficient layer and will be selected bearing the desired characteristics in mind." Since no particular reason for these specific percentages is claimed, it is understood that they are for a specific performance as stated by Villiers et al.

With respect to claim 17, Choi in view of Baravian discloses the filter media of claim 1 as discussed above. Choi in view of Baravian does not disclose said thicknesses comprising an intermediate thickness and a fine thickness of fibers all of approximately one half to tow inches in length with the intermediate thickness advantageously comprised of approximately of 40 percent 6 denier fibers, 10 percent 3 denier fibers, and 50 percent 4 denier low melt fibers; and, the fine thickness advantageously comprised approximately of 40 percent 3 denier fibers, 10 percent 1 denier fibers, and 50 percent 4 denier low melt fibers.

Villiers et al. teaches a multi layer filter media comprised of a combination of low melt and regular fibers of approximately 1/2-2 inches in length. Villiers et al. does not teach the specific percentages of denier fibers. In Column 5, Lines 10-16, Villiers et al states "The relative percentages of the components and fibres . . . will determine the performance of the efficient

layer and will be selected bearing the desired characteristics in mind." Since no particular reason for these specific percentages is claimed, it is understood that they are for a specific performance as stated by Villiers et al.

15. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Choi in view of Baravian, Ahr, Badolato, Villiers et al., and Choi2. Choi in view of Baravian and Ahr discloses a multi-thickness filter media comprising at least three different fiber sizes in successive horizontally extending adjacent face-to-face independent thicknesses of carded, chopped fibers (Baravian, Col. 1, Lines 15-20), said carded, chopped fibers of each independent thickness having a combination of fibers and pore size characteristics (Choi, Col. 3, Lines 10-15) with the carded, chopped fibers of each independent thickness being substantially opened and aligned (Ahr, Col. 16, Lines 60-65), with pore sizes decreasing from the finer downstream lower denier thickness toward the coarser upstream higher denier thickness (Choi, Col. 2, Lines 11-20), the carded fibers in said thicknesses being calculated so that the overall average pore size of the combined adjacent successive thicknesses is smaller than the pore size of said independent finest fiber thickness (Choi, Col. 3, Lines 60-65) by the formula expressed:

$\frac{1}{M} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n \left(\sum_{i=1}^{n} \frac{1}{M_i} \right)$ (Choi, Col. 6, Lines 20-65). Choi in view of Baravian and Ahr does not disclose the fiber size characteristics from downstream toward upstream thicknesses being approximately one to four, six, and at least twenty deniers from downstream finer denier thickness toward said upstream coarser thicknesses; said adjacent face-to-face thicknesses being bonded by a selected acrylic binder, and the formula: $\frac{1}{v} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n (\sum_{i=1}^{n} \frac{1}{v_i})$.

Badolato et al. teaches at least three different denier fibers with the denier characteristics

of each being approximately one to four, six, and at least twenty (Col. 2, Lines 30-60). It would have been obvious to one of ordinary skill in the art at the time the invention was made to place these specific denier measurements in Choi in view of Baravian and Ahr, as taught by Badolato et al since the denier characteristics would be tailored for the specific filtering application (see Villiers et al. (Col. 5, Lines 10-16). Rotter teaches said chemical binding agent being a selected acrylic binder (Col. 6, Lines 7-10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use an acrylic binder in Choi in view of Baravian and Ahr, as taught by Rotter for forming a relatively rigid mat (Col. 6, Line 9).

Choi2 teaches the following equation: $v = (\sum_{i=1}^{n} \frac{1}{v_i})$, which with the addition of the ratio of the pore volume to the total volume of the media, ε, would yield the claimed equation. It would have been obvious to one of ordinary skill in the art to use the equation in Choi in view of Baravian and Ahr, as taught by Choi2, to predict the air permeability and the pore distribution of the multi-layered nonwoven filter medium (Choi2, P. 62, 1st paragraph).

16. Claims 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. (5,805,452) in view of Choi. With respect to claim 19, Anthony et al. discloses a method of manufacturing comprising: collecting a first independent measured thickness weight of chopped fibers in a mixer-blender zone (2110); collecting at least a second independent measured thickness weight of chopped fibers in a mixer-blender zone to be successively joined in overlying face-to-face thicknesses relation with said first measured thickness weight of chopped fibers; passing said first and second measured thicknesses weights to a carding zone (2124) to open and align said chopped fibers in each said successively joined filter media thicknesses

having face-to-face relationship to maximize particulate dirt holding capacity (Col 48, Lines 5-20). Anthony et al. does not disclose said measured thicknesses being of selected denier and pore size different from each other and one being finer than other, nor said thicknesses being calculated so that the overall average pore size of the combined successive face-to-face thicknesses is smaller than the pore size of the independent finest filter thicknesses.

Choi teaches a multi-layer filter media comprising a combination of at least two successive adjacent face-to-face thicknesses of fibers, said fiber sizes of each thickness having a combination of fiber sizes so that the pore size characteristics of one thickness differs from that of an adjacent thickness with said fibers of one thickness being comparatively finer than said fibers of said other thickness (Col 3, Lines 10-15) and with the fiber sizes and pore sizes of said successive adjacent face-to-face thicknesses of fibers being calculated so that the overall average pores size of the combined successive thicknesses is smaller than the pore size of the combination of finest fiber thickness (Col 3, Lines 60-65), so as to optimize filtration performance efficiency. It would have been obvious to one of ordinary skill in the art at the time the invention was made to produce the filter media of Choi, as taught by Anthony et al. since the process can be used to process other types of materials (Col. 61, Lines 4-6).

With respect to claim 20, Anthony et al. discloses the method as discussed above in claim 19. Anthony et al. does not disclose the method wherein said face-to-face filter media thicknesses are selected in said mixer-blender zone to have decreasing denier and decreasing pore size when positioned in an upstream to downstream line of flow during filtering operation.

Choi teaches the filter media arrangement , wherein said successive thicknesses extend

horizontally, with the upstream thickness of said combined successive thicknesses being of higher porosity and higher denier characteristics than a downstream thickness. (Col. 2, Lines 11-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to produce the filter media of Choi, as taught by Anthony et al. since the process can be used to process other types of materials (Col. 61, Lines 4-6).

17. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. in view of Choi as applied to claim 19 above, and further in view of Villiers et al. Anthony et al. in view of Choi as applied to claim 19 above disclose a method of manufacturing filter media comprising: collecting a first independent measured thickness weight of chopped fibers in a mixer-blender zone, said first independent measured thickness weight of chopped fibers being of selected denier and pore size; collecting at least a second independent measured thickness weight of chopped fibers in a mixer-blender zone to be successively joined in overlying face-to-face thicknesses relation with said first measured thickness weight of chopped fibers, said second measured thickness weight of chopped fibers being of selected denier and pore size different from said denier and pore sizes of said first measured thickness weight of chopped fibers with said fibers of one independent thickness being finer than said fibers of said other independent thicknesses; passing said first and second measured thickness weights to a carding zone to open and align said chopped fibers in each said successively joined filter media thicknesses having face-to-face relationship to maximize particulate dirt holding capacity and to increase efficiency with the thicknesses being calculated so that the overall pore size of the combined successive face-to-face thicknesses is smaller than the pore size of the independent finest filter thickness. Anthony et al. in view of Choi does not disclose said face-to-face filter media thicknesses each

carded separately in said carding zone in successive steps and positioned in overlying face-to-face bonded relationship.

Villiers et al. teaches face-to-face filter media thicknesses each carded separately in said carding zone in successive steps and positioned in overlying face-to-face bonded relationship (Col. 5, Lines 23-35). It would have been obvious to one of ordinary skill in the art at the time the invention was made to card the thicknesses of Anthony et al. in view of Choi separately, as taught by Villiers et al. since this is simply a design choice.

18. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. in view of Choi as applied to claim 19 above, and further in view of Rotter (5,425,672). Anthony et al. in view of Choi as applied to claim 19 above disclose a method of manufacturing filter media as described above. Anthony et al. in view of Choi does not disclose said filter media thicknesses being bonded to each other by a selected bonding spray.

Rotter teaches filter media thicknesses being bonded to each other by a selected bonding spray (Col. 6, Lines 1-10). It would have been obvious to one of ordinary skill in the art at the time the invention was made to spray the thicknesses of Anthony et al. in view of Choi with a selected bonding spray, as taught by Rotter so that they would be bound into a relatively rigid mat for use as a filter media. (Col. 6, Lines 1-15).

19. Claims 23-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. in view of Choi as applied to claim19 above, and further in view of Villiers et al. With respect to claim 23, Anthony et al. in view of Choi as applied to claim 19 above, disclose a method of manufacturing the filter media as discussed above. Anthony et al. in view of Choi

does not disclose one of said filter media thicknesses is of low melt fibers, said filter media thicknesses being bonded to each other by heating.

Villiers et al. teaches a filter media thickness of low melt fibers, where the thicknesses being bonded to each other by heating (Col. 5, Lines 10-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to bind the thicknesses of Anthony et al. in view of Choi with heat, as taught by Villiers et al. for providing improved rigidity and stability (Col. 5, 45-50).

With respect to claim 24, Anthony et al. in view of Choi as applied to claim 19 above, disclose a method of manufacturing the filter media as discussed above. Anthony et al. in view of Choi, in further view of Villiers et al. also discloses at least one of said filter media thicknesses is of low melt fibers, said filter media thicknesses being bonded to each other by heating. Anthony et al. in view of Choi does not disclose said low melt fiber melting being in the approximate range of two hundred to four hundred degrees Fahrenheit.

Villers et al. teaches a low melt fiber melting being in the approximate range of two hundred to four hundred degrees Fahrenheit (Col. 5, Lines 15-20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to have low melt fibers with a melting temperature range of 200-400°F in Anthony et al. in view of Choi, as taught by Villiers et al. since this is simply a design choice.

20. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. in view of Choi, and Choi2. Anthony et al. discloses the method as stated above in claim 19. Again as stated in the 35 U.S.C. 112 rejections, it is unclear which claim 25 is dependent from, it will be assumed to be dependent on a method claim, i.e. claim 19. Anthony et al. does not disclose

said calculation of face filter media thicknesses being expressed by the formulas:

$$\frac{1}{M} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n \left(\sum_{i=1}^{n} \frac{1}{M_i} \right), \text{ and } \frac{1}{v} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n \left(\sum_{i=1}^{n} \frac{1}{v_i} \right).$$

Choi discloses $\left(\frac{M_2}{M_1 M_3} \right)^2 = \frac{L_2}{L_1 L_3}$, where M is the mean flow pore size and L is the corresponding thickness, for a triple layer medium (Col. 6, Lines 20-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include the ratio of the pore volume to the total volume of the media, ε, in the equation of Choi, and solve, thus yielding the above equation to design the multi-layer filter media (Col. 6, Lines 64-65) by the prediction of the average pore size for "n" layered media.

Choi2 teaches the following equation: $v = \left(\sum_{i=1}^{n} \frac{1}{v_i} \right)$, which with the addition of the ratio of the pore volume to the total volume of the media, ε, would yield the claimed equation. It would have been obvious to one of ordinary skill in the art to use the equation in Choi, as taught by Choi2, to predict the air permeability and the pore distribution of the multi-layered nonwoven filter medium (Choi2, P. 62, 1st paragraph).

21. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. in view of Choi as applied to claim 19 above, and further in view of "Prediction Of Air Permeability And Pore Distribution Of Multi-Layered Nonwovens" by Choi, hereafter referred to as Choi2. Anthony et al. in view of Choi as applied to claim 19 above disclose a method of manufacturing filter media as discussed above. Anthony et al. in view of Choi do not disclose

said calculations including an air frazier permeability calculation expressed by the formula:

$$\frac{1}{v} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n \left(\sum_{i=1}^{n} \frac{1}{v_i}\right).$$

Choi2 teaches the following equation: $v = \left(\sum_{i=1}^{n} \frac{1}{v_i}\right)$, which with the addition of the ratio of the pore volume to the total volume of the media, ε, would yield the claimed equation. It would have been obvious to one of ordinary skill in the art to use the equation in Anthony et al. in view of Choi, as taught by Choi2, to predict the air permeability and the pore distribution of the multi-layered nonwoven filter medium (Choi2, P. 62, 1st paragraph).

22. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Anthony et al. in view of Choi, Villiers et al., and Choi2. Anthony et al. in view of Choi disclose a method of manufacturing multi-layered filter media comprising: collecting in a mixer-blender zone (Anthony et al., 2110) at least a first and second layer of chopped fibers in separate independent thickness layers, each layer of filter media being of measured weight with said fibers of one independent layer being finer than said fibers of said other independent layer fibers; passing each layer through a carding zone (Anthony et al., 2124) for each to open and align the fibers of each layer; said carded fibers in said bonded layers being calculated so that the overall average pore size of the combined adjacent successive layers is smaller than the pore size of said independent finest fiber thickness layer (Choi, Col. 3, Lines 60-65) calculated by the formula expressed:

$$\frac{1}{M} = \varepsilon_i \varepsilon_{i+1} \ldots \varepsilon_n \left(\sum_{i=1}^{n} \frac{1}{M_i}\right)$$ (Choi, Col. 6, Lines 20-65).

Villiers et al. teaches face-to-face filter media thicknesses each carded separately in said

carding zone in successive steps and positioned in overlying face-to-face bonded relationship (Col. 5, Lines 23-35). It would have been obvious to one of ordinary skill in the art at the time the invention was made to card the thicknesses of Anthony et al. in view of Choi separately, as taught by Villiers et al. since this is simply a design choice. Villiers et al. teaches a filter media thickness of low melt fibers, where the thicknesses being bonded to each other by heating (Col. 5, Lines 10-65). It would have been obvious to one of ordinary skill in the art at the time the invention was made to bind the thicknesses of Anthony et al. in view of Choi with heat, as taught by Villiers et al. for providing improved rigidity and stability (Col. 5, 45-50).

Choi2 teaches the following equation: $v = (\sum_{i=1}^{n} \frac{1}{v_i})$, which with the addition of the ratio of the pore volume to the total volume of the media, ε, would yield the claimed equation. It would have been obvious to one of ordinary skill in the art to use the equation in Anthony et al. in view of Choi, as taught by Choi2, to predict the air permeability and the pore distribution of the multi-layered nonwoven filter medium (Choi2, P. 62, 1st paragraph).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elizabeth Revis whose telephone number is 703-305-3437. The examiner can normally be reached on M-F 7:00am - 3:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wanda L. Walker can be reached on 703-308-0457. The fax phone numbers for the

organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

ER
January 28, 2002

W. L. WALKER
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700